Learning to Read and Spell Words: Theory, Research, and Instruction

Linnea Ehri
Distinguished Professor Emerita
Ph.D Program in Educational Psychology
Graduate Center
City University of New York

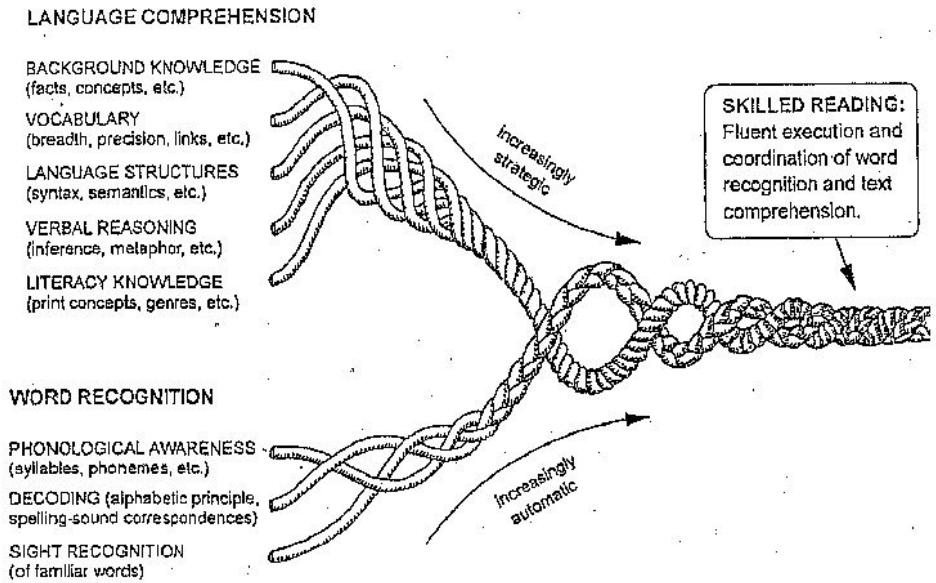
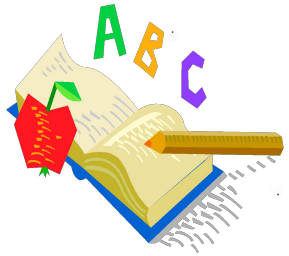
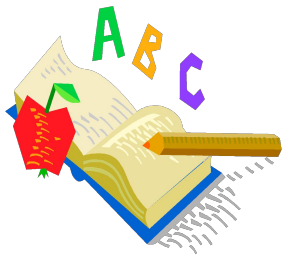


FIGURE 8.1. Illustration of the many strands that are woven together in skilled reading.

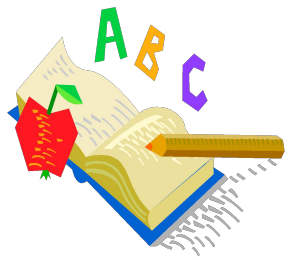




CUNY
Graduate
Center

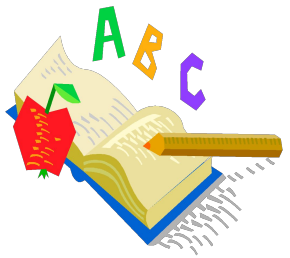
Empire State Building – Midtown Manhattan

Science of Reading Research



- Theory about how children learn to read words
- Pinpoint cause-effect relations
- Compare treatment to comparison conditions
- Test hypothesis: treatment group will learn more than the comparison group
- Co-authors: Lee Wilce, Alpana Bhattacharya, Nancy Boyer, Susan Chambre, Julie Rosenthal, Renan Sargiani, Adina Shmidman, Howard Fogel, Katie Pace Miles, Pat Masonheimer, Robin O'Leary

Ken Goodman's Psycholinguistic Theory



- Reading is a psycholinguistic guessing game…
- Efficient reading does not result from precise identification of letters and words
- It results from skill in selecting the fewest, most productive cues necessary to produce guesses which are right the first time.
- The reader samples graphic cues combined with semantic and syntactic expectations to read text.
  - Evidence: miscues – misreading *house* as *home, fortune* as *future*

- From "Reading: A Psycholinguistic Guessing Game" by Kenneth Goodman. In Singer & Ruddell, *Theoretical models and processes of reading*. IRA, 1976.

Doubt and Alternative Theory

- Readers read most words accurately in text
- Only a few miscues
- Miscues may not reveal how most words are read
- Alternative theory:
  - Read words from memory: spellings bonded to pronunciations and meanings
  - Look at words and read them automatically
  - No need to sample cues and guess
  - Match written word on page to spelling stored in memory

Ways to Read Words

1. By Decoding

Transform graphemes into phonemes and blend to pronounce a word

Phonemes are smallest sounds in words (depicted by IPA symbols)

Graphemes are 1 or more letters that represent phonemes

D O G /d/ /a/ /g/ “dog”

CH E CK /č/ /Ɛ/ /k/ “check”

Segment and blend multi-letter units: syllables, affixes, root words

EXCELLENT /ex/ /cel/ /lent/

UPHOLDING /up/ /hold/ /ing/

Ways to Read Words

2. By Analogy: adapt known word to read unknown word

j ump □ d ump

n ight □ br ight

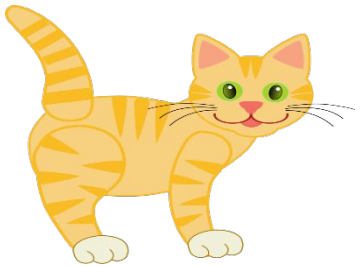
3. By Prediction: use of context & partial letters

- At the hospital, the doctors and n……

4. From Memory / By Sight: sight of written word activates its spelling, pronunciation and meaning in memory automatically

Dog □ "dog"

Cat □ "cat"



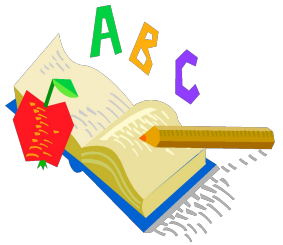
Which Way is Used to Read Words?

WORDS NEVER READ BEFORE

Decoding

Analogy

Prediction



WORDS READ BEFORE AND STORED IN MEMORY

Read by sight automatically

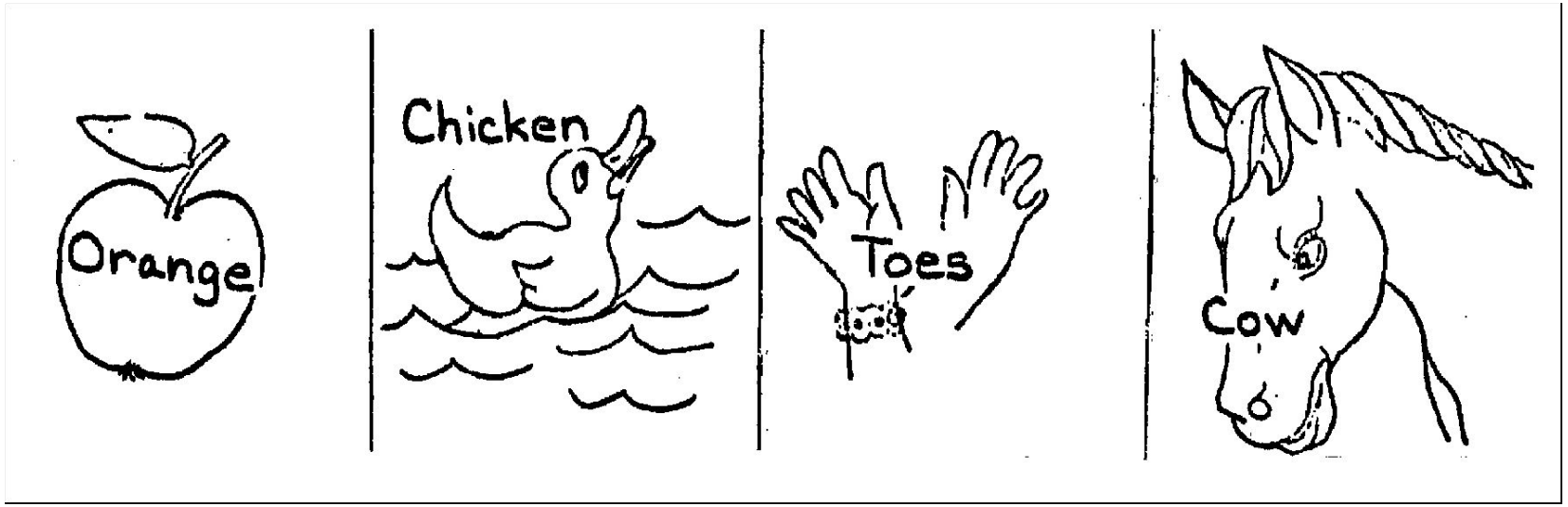
Frees up readers' attention to focus on meaning of text

Note: **All words** when practiced become read from memory by sight

AUTOMATICITY – Stroop Task

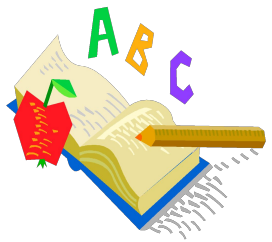
Task: Name the color or picture. **Do not read the words**

RED GREEN BLUE BLACK



Evidence that familiar words are read automatically from memory.

How Are Sight Words Learned?



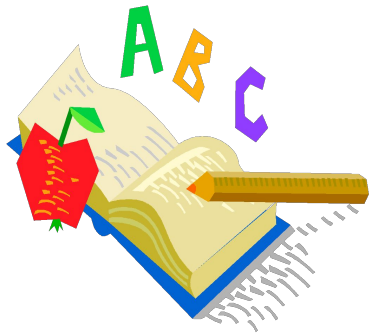
FACTS TO EXPLAIN

- Thousands of words are recognized in an instant
- Word shapes are not distinctive
- Similarly spelled words aren't confused
  - Stick, sick, slick, stink, stiff
- Accuracy is high, especially in text
- Words are learned quickly – little practice required

CONCLUSION

- Visual memory can't explain learning
- Powerful mnemonic system is needed to explain how spellings of words get into memory
  - Like crazy glue

Reading Words from Memory



- Process of forming connections called **<u>orthographic mapping</u>**

Spelling

glue

Pronunciation

Knowledge of the grapheme-phoneme system provides the *<u>glue</u>* connecting spellings to pronunciations in memory

Examples of grapheme-phoneme connections for regularly spelled words

S T O P

/s/-/t/-/o/-/p/

CH E CK

/ch/-/e/-/k/

Graphemes

Phonemes

G I GG LE

/g/-/I/-/g/-/L/

B IR D

/b/-/r/-/d/

Graphemes

Phonemes

Examples of grapheme-phoneme connections for irregularly spelled words

I S* L A N D

/ay/-/l/-/a/-/n/-/d/

S W* O R D

/s/ - /o/ - /r/ - /d/

◄ Graphemes

◄ Phonemes

L I S T* E N

/l/-/i/-/s/-/e/-/n/

S I G* N

/s/ - /ay/ - /n/

◄ Graphemes

◄ Phonemes

* “Silent” letters

Forming connections to bond spellings of words to their pronunciations in memory

KNOWLEDGE NEEDED

Phoneme segmentation

- Analyzing phonemes in pronunciations of words

Grapheme-phoneme (GP) units

- Knowing how graphemes represent phonemes systematically **(the glue)**

ORTHOGRAPHIC MAPPING PROCESS

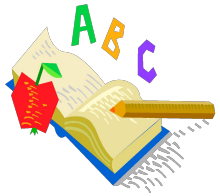
Decoding (use GPs to transform spellings into pronunciations)

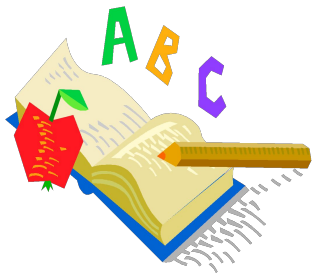
Spelling (use GPs to spell pronunciations)

Automatic mapping (see spelling and hear pronunciation)

More advanced readers – knowledge used for mapping

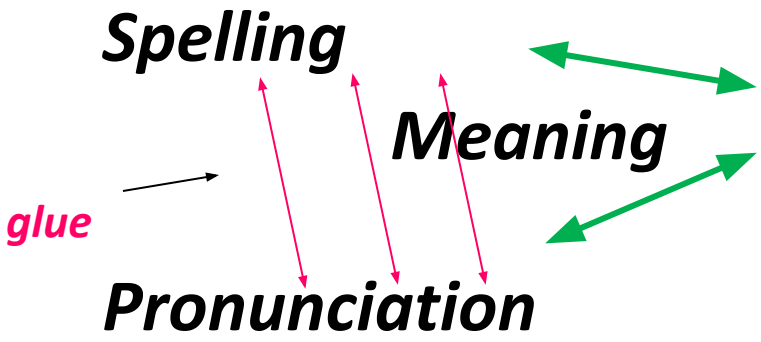
Multi-letter spelling units representing syllables, affixes, root words





Reading Words from Memory

- Process of forming connections called **orthographic mapping**



Knowledge of the grapheme-phoneme system provides the *glue* connecting spellings to pronunciations in memory

Forming Connections to Meaning:

Example:
How remember that *manky* means *dirty*?

Word Reading: Phases of Development

Growth is governed by the predominant type of alphabetic connection used to read and spell words

Phase 1: Pre-alphabetic

Use of visual, non-alphabetic connections

Phase 2: Partial alphabetic

Use of partial letter-sound connections

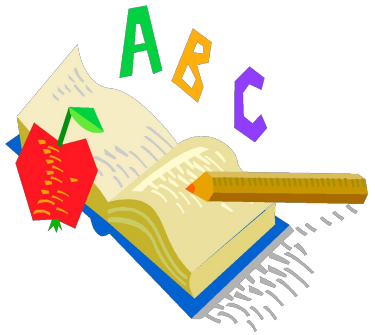
Phase 3: Full alphabetic

Use of more complete grapheme-phoneme connections

Phase 4: Consolidated alphabetic

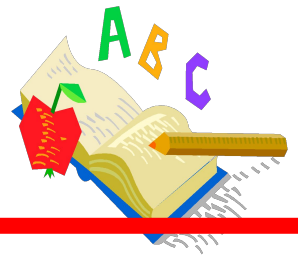
Use of multi-letter connections for syllables, affixes

Examples: -ING, -TION, PRE-, CON-; IN – TER – EST - ING



Pre-alphabetic Phase

- Pre-readers
    - Cannot decode words; cannot read text independently
- No use of letter-sounds to read or spell
- Writes words with random, pseudo or memorized letters not connected to sounds
    - Example: writing letters in own name
- Pretends to read by memorizing words in stories
- Uses visual cues to remember how to read words and environmental print



VISUAL CUES USED TO READ WORDS

Colors, logo, golden arches to read McDonalds

dog

Tail as visual cue

camel

Two humps as visual cue

LOOK

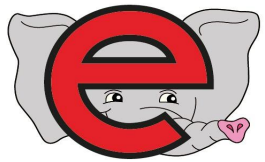
Eyes as visual cues to read LOOK

Colors and logo – Misread as Pepsi

Movement into the Partial Alphabetic Phase

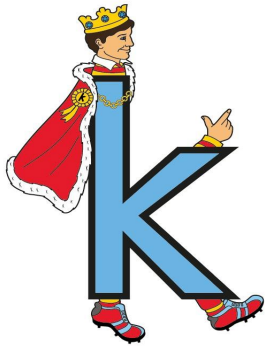
- Letter shapes and names
- Grapheme-phoneme relations
- Teach with embedded picture mnemonics


Annie Apple


Eddy Elephant


Sammy Snake


Zig Zag Zebra


Kicking King

From L. Wendon, *Letterland ABC*.

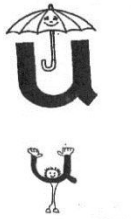
Teaching Short Vowel Grapheme-phoneme Relations


Annie Apple makes the sound at the beginning of her name - ă (as in ăpple)


Eddy Elephant makes the sound at the beginning of his name - ĕ (as in ĕlephant).

itchy itch

olive octopus



uppy umbrella

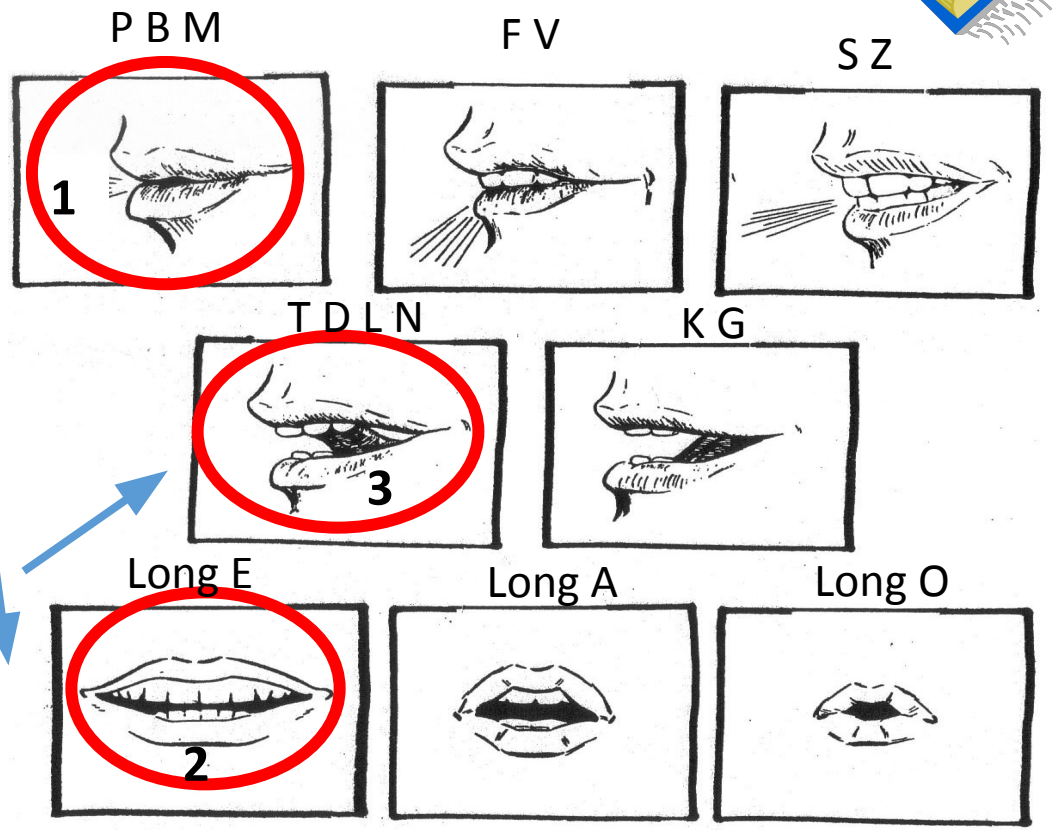
Movement into the Partial Alphabetic Phase

- Awareness of phonemes in words:
  - Segment words into phonemes
  - Use letters to segment phonemes
  - Analyze mouth positions and movements

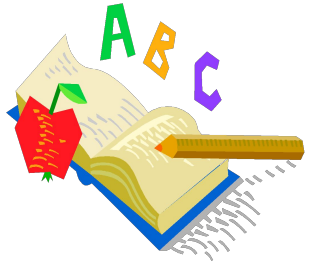
    Example: meat

    Move mouth pictures into boxes

    Examine mouth in mirrors



Children in the Partial Alphabetic Phase



- Can write partial letter-sound spellings of words
  - Examples: BP for bump; KR for car; YL for while
- Very hard to remember correct spellings of words
- Cannot decode new words
- Can guess words from partial letters or context
- Can read words by sight
  - Connects partial letters to sounds in words
  - Misreads words sharing similar letters: *stop* for *step*
  - Not fully accurate
- Struggling readers stuck in this phase

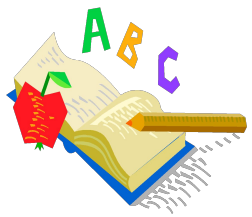
/s/ /p/

S T E P

Invented Spellings in the Partial Phase

* Window revealing child's knowledge of letter-sound mappings
* Child detects sounds in letter names to spell (H contains /ch/)
* Spellings are partially phonetic – you can read some of them
* But spellings are not correct

Bt (boat)
Grl (girl)
Hkn (chicken)
Fns (friends)
Nar (nature)
Drde (dirty)
Mosr (monster)



Movement into Full Alphabetic Phase

- Learn the major grapheme-phoneme relations
  - Glue for orthographic mapping
- Segment spoken words into phonemes proficiently
- Using grapheme-phoneme relations to decode and spell words
- Orthographic mapping to build sight words in memory
  - By connecting all graphemes to phonemes to bond spellings to pronunciations and meanings in memory

Movement into the Full Phase
Teaching Grapheme-Phoneme Mapping

- Study with 1st graders in the partial phase
  - Knew letter names but not sounds
  - Could not decode novel words
- Spoken words in Portuguese
  - Syllables are salient
  - Spelled consistently in written words
  - Examples: escola – 3 syllables; alfabeto – 4 syllables
- Beginning reading instruction: read whole syllables
  - Examples: SA SE SI SO SU; MA ME MI MO MU

Teaching Grapheme-Phoneme Mapping

- Children randomly assigned to 3 treatments:
  - Decode syllables with grapheme-phoneme units
  - Read whole syllables
  - No decoding; practice single grapheme-phoneme relations
- Training Sets
- Set 1: SA, SE, SI, SU, ME, MI, MO, MU
  Set 2: FA, FE, FO, FU, ZE, ZI, ZO, ZU
  Set 3: VA, VI, VO, VU, LA, LI, LO, LU
  Set 4: BA, BE, BI, BO, TA, TE, TO, TU
  Set 5: DA, DE, DI, DU, PA, PE, PI, PO
- Review Set
- BA, BI, DE, DU, FA, FU, LI, LO, ME, MU,
  PA, PO, SE, SU, TA, TU, VI, VO, ZE, ZI

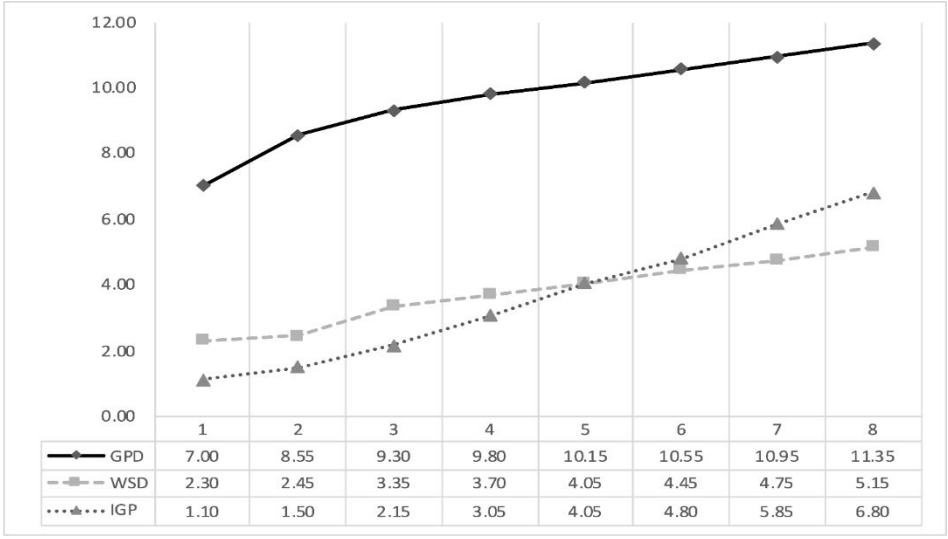
Training continued until each child could read all syllables perfectly

Results

- Decoding group far outperformed syllable and letter-sound groups
  - During training: they learned to read syllables perfectly much faster
  - After training
    - They could read syllables that were not taught much better
    - They could segment and blend phonemes in spoken words much better
    - They could spell words much better
    - They learned to read 12 words from memory by sight much better

Examples:

LOTADU, PALITU, SUBIDA



	1	2	3	4	5	6	7	8
GPD	7.00	8.55	9.30	9.80	10.15	10.55	10.95	11.35
WSD	2.30	2.45	3.35	3.70	4.05	4.45	4.75	5.15
IGP	1.10	1.50	2.15	3.05	4.05	4.80	5.85	6.80

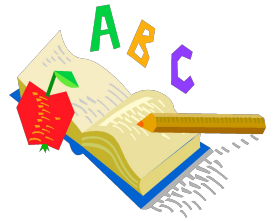
Results

- Surprising findings
  - Syllable students did not learn grapheme-phoneme relations
  - 95% scored zero when asked to say the sounds of letters
  - 85% could not segment any words into phonemes
- Despite knowing all the letter names that contained phonemes in their names
- Despite extensive practice reading syllables over and over till perfect

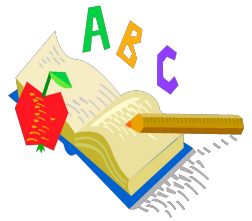
- Movement from partial to full alphabetic phase
- Requires learning to decode words using grapheme-phoneme units
- Goal of systematic phonics instruction

Other Developments in the Full Alphabetic Phase

- Sight word reading vocabulary grows
- Word reading becomes accurate
    - Words are recognized automatically
- Children can write more complete grapheme-phoneme spellings
- Children can remember correct spellings of words that are consistent with their knowledge of the spelling system
- Children can read text at their level independently



Movement into the Consolidated Alphabetic Phase



- Recurring letter patterns become consolidated into larger units
  - Examples: **-amp** in camp, damp, lamp, champ
  - Spellings of syllables, prefixes suffixes
    - -ing, -ed, -ack, -ake, -est, pre-, -tion

- Readers use multi-letter units to form connections for sight word learning

Examples: **IN TER EST ING; UP HOLD ING**

Orthographic mapping of syllables to read words

digit, di git

poverty, po ver ty

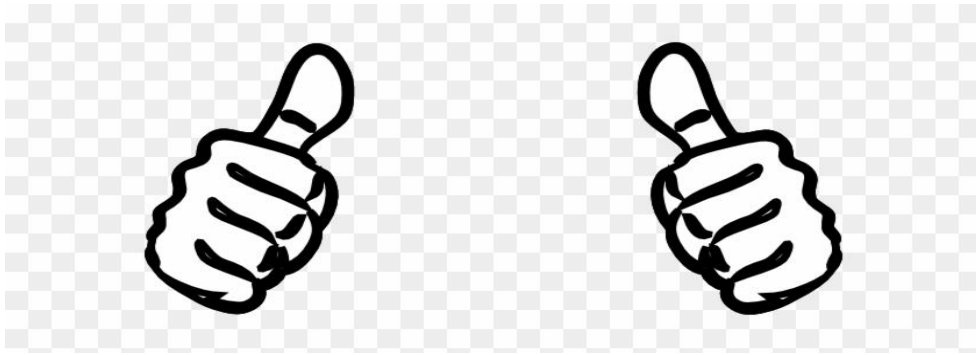
congress, con gress

utensil, u ten sil

microphone, mi cro phone

walnut, wal nut

notify, token, sacrifice, welfare, victim, mustard, democratic, testimony, cavity, vanilla, cathedral, senator, mental, congratulate, conference, binoculars, power, pistol, visual.



1. Read word
2. Isolate spelling of each syllable with thumbs while pronouncing it,
3. Blend syllables to read whole word

Treatments and Results

- Adolescent struggling readers – 3rd GE reading level
- Practice reading multisyllabic words
  - 1. Syllable mapping
  - 2. Whole word reading
- Results: Syllable group learned to read and spell words much better than the whole word group.
- Explanation:
  - Orthographic mapping of syllables created more complete connections to connect spellings to pronunciations in memory.
  - Syllable reading practice increased knowledge of consolidated spelling units.

Vocabulary Learning Studies

Students are taught pronunciations and meanings of unknown words

They see spellings in one condition

They do not see spellings in the other condition

Memory for words is tested when spellings are not present.

- Examples of words taught to 2nd graders
  - Gam – family of whales
  - Cur – a homeless dog
  - Sod – wet, grassy ground
  - Fet – big, fun party
  - Nib – tip of a pen
  - Yag – fake jewelry
  - Keg – a barrel that holds water

Vocabulary Learning Study

Spelling Seen Condition

Nib

Spelling Not Seen Condition

Vocabulary Learning Studies: Findings

- Exposure to spellings improved memory for pronunciations compared to no spellings
- Also improved memory for meanings
- Learning was incidental:
  - No attention to spellings;
  - Orthographic mapping activated automatically
- Memory improved more when students decoded spellings
- Orthographic facilitation has been observed in many types of readers

  Kindergarten through adulthood,

  Students with dyslexia, autism, Down syndrome,

  English language learners, bilingual students.

Vocabulary instruction: Students should see and decode spellings,

Research on Teacher Knowledge: Orthographic Mapping to Teach AAE

African American English is structured and follows grammatical rules

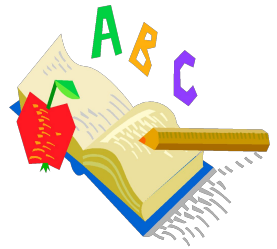
- Omission of possessive s (Bob friend)
- Omission of past tense ed (Yesterday she play)
- Omisson of plural s (Three book)
- Omission of 3rd person singular s present tense marker (Jessica live)
- Omission of linking verb copula is (He tired)
- Subject expression (David he go to school)
- Indefinite article (a orange)

Research on Teacher Knowledge: Orthographic Mapping to Teach AAE

- Many teachers lack knowledge of the structure of African American English (AAE)
  - Don’t recognize examples in their students’ writings.
  - Origin in spoken language not recognized

- To teach writing, they need to understand what causes students to deviate from Standard English.

Three treatments compared



- Teachers were taught these structures in one of three ways:

  1. EXPOSURE: Exposure to AAE forms by reading 3 stories; instructed to pay attention to grammatical features that distinguish AAE from standard English (SE) forms

  2. EXPOSURE PLUS EXPLANATION: Read 2 stories. Worksheets displaying examples of AAE forms and SE equivalents; examples explained and reviewed by experimenter

  3. EXPOSURE, EXPLANATION, PRACTICE: Read 1 story; reviewed worksheets; practiced translating and writing SE sentences into AAE equivalents

Three treatments compared

- Teachers were taught AAE structures in one of three ways:
  1. EXPOSURE: reading 3 stories;
  2. EXPOSURE PLUS EXPLANATION: Read 2 stories. Worksheets
  3. EXPOSURE, EXPLANATION, PRACTICE: Read 1 story; worksheets; translating SE sentences into AAE

Findings on tests after training

Test: translate 9 written SE sentences into AAE

Groups 2 & 3 did better than Group 1 (79%, 84%, 44% correct)

Test: write a story using AAE forms:

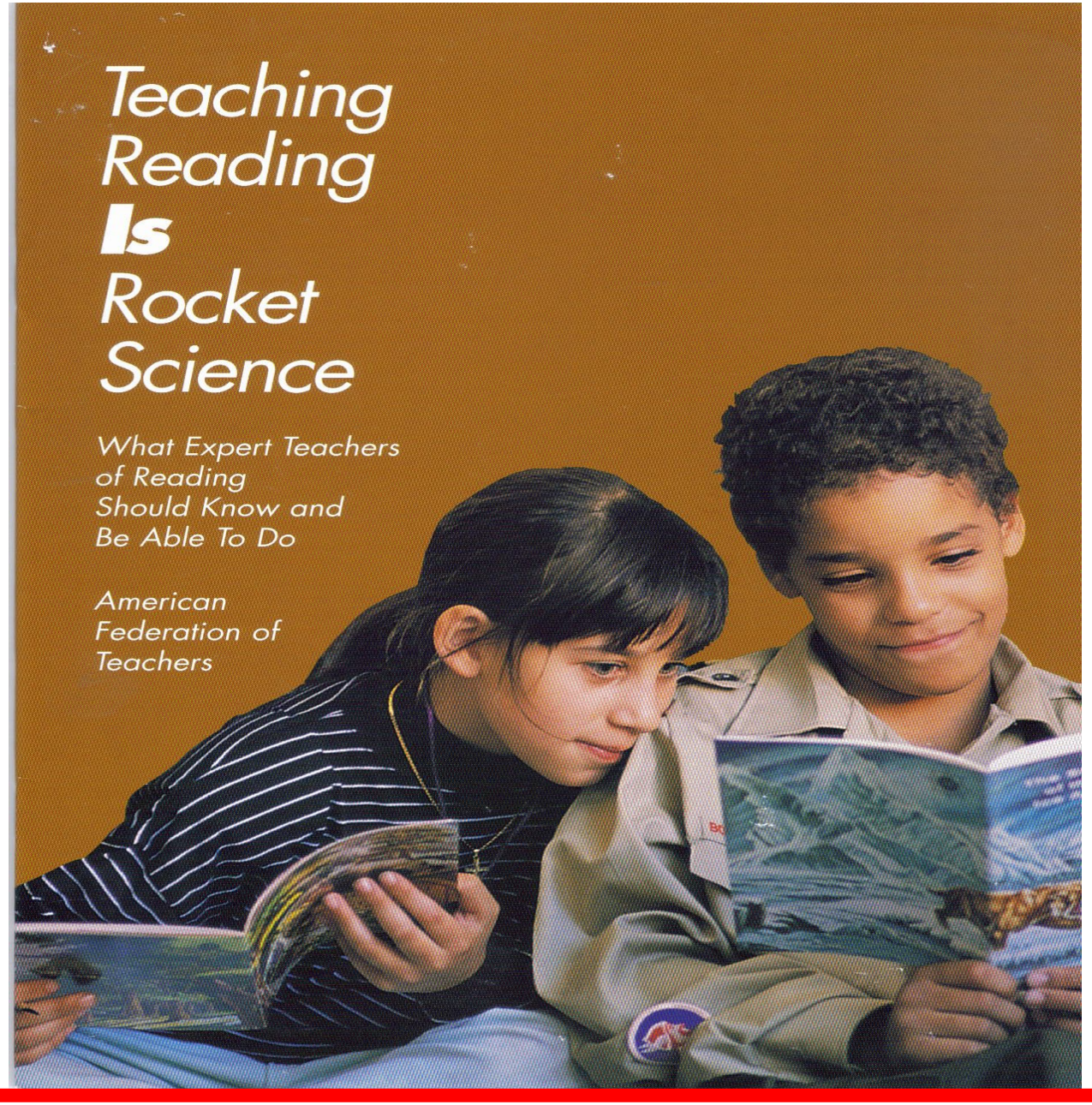
Group 3 did better than Group 2 who did better than Group 1

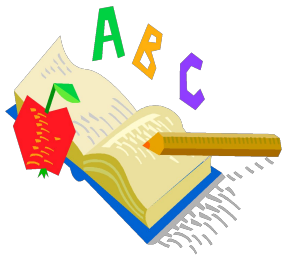
(85%, 71%, 46% of sentences written correctly)

Conclusions:

- Explicit instruction can make teachers aware of AAE grammatical structures

- Most effective instruction includes not only exposure and explanation of the forms but also practice in orthographically mapping Standard English into African American English

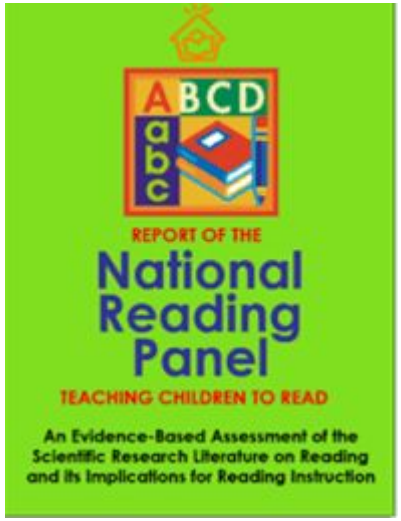




Written By Louisa Moats

"As a physicist chairing this panel for two years and preparing this report, I have come to realize that teaching reading is really much *harder* than rocket science!"

Dr. Donald Langenberg, Chair of the National Reading Panel, 2000



LEhri@gc.cuny.edu